ISSN 2321 – 919X

The International Journal of Science & Technoledge

Volume 10 Issue 6

June, 2022

www.theijst.com

THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

The Influence of CNC Laboratory Facilities on Students' Learning Achievement in NC/CNC Machinery Practical Courses of Mechanical Engineering Education, Universitas Negeri Makassar

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Abstract:
This research is a descriptive quantitative study that aims to determine the effect of CNC Laboratory Facilities on Student Achievement in the NC/CNC Machine Practice Course at S1 Mechanical Engineering Education Students, Makassar State University. The independent variable in this research is CNC laboratory facilities and the dependent variable is students' achievement in the NC/CNC machining practice course. The population and sample of this study were students majoring in mechanical engineering education which consisted of 30 students from the 2017 and 2018 batches. The research data were obtained from the distribution of questionnaires and documentation of learning achievement scores. The data analysis technique is descriptive analysis and simple linear regression analysis. Researchers used SPSS 21.0 program assistance in data analysis with a significant level of 5% to see the magnitude of the influence given by the independent variable on the dependent variable. Based on the results of the analysis, it was found that CNC laboratory facilities had a positive effect of 21.1%, on students' achievement in the NC/CNC machining practice course at Makassar State University Mechanical Engineering Education, while the remaining 78.9% was influenced by other variables that were not investigated in this study.

Keywords: *NC/CNC, laboratory facility, practicum, learning achievement*

1. Introduction

The university is one of the formal institutions that has a major role in fostering and fulfilling experts who master science and technology. The role of this university is intended to balance the world of industrial technology which is also progressing very rapidly so as to produce various creations in all things that aim to facilitate all human activities. One of the skills needed by the industrial world at this time is expertise in the field of machinery. The Department of Mechanical Engineering Education, Faculty of Engineering, Makassar State University is one of the providers of formal education that participates in producing personnel who have knowledge and skills. Efforts to improve the quality of human resources (HR) are carried out by improving education. The quality of education is determined by several factors, including: educators, students, learning process, environment, learning facilities and learning time. Complete laboratory facilities can increase students' achievement to be more active and get comfortable while carrying out practice. If the laboratory equipment is incomplete or most of it is damaged so that it cannot be used, then things like this are also an obstacle in implementing practices that make students' achievement and knowledge less than optimal.

The readiness of the laboratory to support the implementation of the practicum process cannot be separated from the availability of tools and materials needed in the implementation of the practicum, time allocation, technicians, and lecturers who have skills and are competent. Mechanical Engineering Education is one of the majors at the Makassar State University campus which is located at Jl, Mallengkeri Raya, Parangtambung, Kec, Tamalate Makassar City, South Sulawesi. This campus has experienced many academic and non-academic developments and improvements, both in terms of facilities, buildings, competent teaching staff, as well as an adequate location for the smooth teaching and learning process.

From the results of initial observations of the completeness of CNC Laboratory facilities, and based on 'Permendikbud No. 3 of 2020 article 35 concerning facilities and infrastructure', the CNC Laboratory of Mechanical Engineering Education UNM is broadly included in the feasible category. The area of the CNC Laboratory is 10 x 6 M^2, and consists of 10 student desks, 2 lecturer desks, 12 chairs, 1 bookcase, 1 tool storage cabinet, 1 material storage cabinet, 1 whiteboard, 2 air conditioners, and 2 trash can. The completeness of the machine itself consists of 4 TU 3a machines, 4 Tu 2a machines, 1 production unit machine and 1 compressor. Complete laboratory facilities, of course, will be a separate point for students in improving skills while practicing NC/CNC machines. If the facilities or laboratory equipment are incomplete, or if most of them are damaged or cannot be used, of course it will have an impact on carrying out practice.

Therefore, it is necessary to carry out an in-depth analysis of the student learning achievements that have not been achieved, especially those caused by the completeness of the NC/CNC Machine Laboratory facilities. Thus, it is necessary to conduct research on 'The Influence of CNC Laboratory Facilities on Student Achievement in NC/CNC Machine Practice Courses in S1 Mechanical Engineering Education Students, Makassar State University'. A good laboratory must be equipped with various facilities to facilitate laboratory practice participants in carrying out their activities. These facilities are in the form of public facilities and special facilities. Public facilities are facilities that can be used by all participants in laboratory practice, for example- lighting, ventilation, water, sinks, electricity and gas. Special facilities are in the form of water equipment and furniture, for example- student or student desks, teacher or lecturer desks, chairs, blackboards, tool cabinets, material cabinets, weighing rooms, fume hoods, first aid kits and fire extinguishers.

The laboratory is an academic support unit in educational institutions- a unit for testing, calibration and production activities on a limited scale using equipment and materials based on certain scientific methods, in the context of implementing education, research and community service. According to Muhamad Ali (2014:1), the laboratory is a means and a place to support the learning process in which it is related to measurement, testing, understanding development, skill development, and innovation in the field of science according to the field of work that exists in schools/educational world. Stated in PP number 19 of 2005 concerning national education standards, article 42 paragraph 2 reads: 'every education unit is required to have facilities and infrastructure which include: land, classrooms, leadership rooms, educator rooms, administrative rooms, laboratory rooms, workshop rooms, library room, production unit room, and rooms that support an orderly and continuous learning process.

The purpose or role of the laboratory, according to Permenpan No. 7 of 2019, explains that the laboratory functions as a place to solve problems, explore facts, train scientific thinking skills, instill and develop scientific attitudes in finding new problems. Based on the standards of the Minister of Education and Culture Number 3 of 2020, it is explained that each skill program has its own standard of facilities. In this study, the authors focus on NC/CNC Laboratory facilities in the NC/CNC machine practice room. The NC/CNC Machine Work Practice Room serves as a place for learning activities to take place. The minimum area of the laboratory space is 64 m^2 including storage and repair space of 16 m^2. The minimum width of the CNC laboratory room is 8 m. The room must have facilities that allow adequate lighting and air circulation. Advances in industrial technology are a reference for organizers to produce workers who have knowledge and skills such as operating NC/CNC machine tools. Laboratory facilities are tools used to achieve an educational goal. Laboratory facilities are needed to facilitate and greatly assist in the smooth working practice of NC/CNC machine tools.

Fasilitas dan prestasi belajar praktik merupakan suatu hal yang tidak dapat berjalan sendiri-sendiri atau terpisahkan. Oleh karena itu, seharusnya semakin baik fasilitas yang dimiliki oleh sebuah laboratorium, maka semakin tinggi pula kemampuannya dalam praktik atau menghadapi pekerjaan termasuk dalam pelaksanaan praktik kerja mesin perkakas NC/CNC. Berdasarkan uraian di atas, maka dapat disimpulkan bahwa fasilitas memiliki pengaruh terhadap prestasi.

2. Method

This study uses a quantitative approach because the observed symptoms are converted into numbers, thus using statistical techniques that can be used to analyze the results. Quantitative data is available in the form of numbers or scoring. This research was carried out for approximately 3 months at the Department of Mechanical Engineering Education, Faculty of Engineering, Makassar State University.

Variables are indicators that determine the success of research because research variables are the object of research or are the point of attention of a study. This study investigates two variables, namely - the independent variable (X) and the dependent variable (Y). The independent variable is CNC Laboratory facilities (X), while the dependent variable is the practical performance of NC/CNC machine tools (Y) for students of Education Department of Mechanical Engineering, Faculty of Engineering, Makassar State University. The Design of the relationship between the dependent variable can be described as follows.

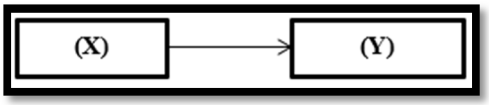

Figure 1

Laboratory facilities are standard learning equipment for expertise program practices that can facilitate and expedite the implementation of a business. Facilities can be divided into two, namely - physical and non-physical facilities. Physical facilities are everything in the form of objects or that can be distinguished which has a role to facilitate and launch

a business, while non-physical facilities are everything that is not an object but has a role in facilitating and launching a business.

The practical achievement of NC/CNC machine tools is a competency possessed by students of the Mechanical Engineering Education Department who have passed the NC/CNC machine tool work practice course. The practical achievement of this NC/CNC machine tool is in the form of scores obtained from the data documentation of the undergraduate study program at the Department of Mechanical Engineering Education, Makassar State University.

The population of this study was all students of the S1 study program, Department of Mechanical Engineering Education, Makassar State University, class of 2017 and 2018, totaling 50 people. The sampling technique used in this research is purposive sampling, namely - the selection of samples by choosing according to the wishes of the researcher based on special characteristics or special requirements to answer the researcher's questions. In this study, the researchers determined the number of samples based on the theory of Fraenkel and Wallen where the minimum sample for quantitative research with a population of 50 people was 30 samples; so, the number of samples taken was 30 people.

Data was collected through documentation, observation and questionnaires. Documentation is used to obtain data on the practical performance of NC/CNC machine tools which can be obtained directly from the Head of the Undergraduate Study Program, Department of Mechanical Engineering Education, Makassar State University. Observations were made to observe directly the condition of the facilities at the NC/CNC Machine Work Laboratory at the Department of Mechanical Engineering Education, Faculty of Engineering, Makassar State University. The questionnaire used in this study is a closed questionnaire with four answer choices. The purpose of distributing the questionnaire is to find out the opinions or responses of students about the influence of laboratory facilities. As a source of information, there are students of the Department of Mechanical Engineering Education, Faculty of Engineering, Makassar State University. The implementation will be carried out in September 2021. The CNC laboratory facility questionnaire is presented in the form of a Likert scale with four alternative answers: strongly agree (4), agree (3), disagree (2) and strongly disagree (1).

The data analysis technique used descriptive and inferential statistics. Descriptive statistical analysis is intended to describe the characteristics of students' ability to practice in accordance with CNC laboratory facilities which are used as a place to practice the average value (Mean), standard deviation (SD), median (Me), mode (Mo), value maximum and minimum values, and will then be presented in the form of tables and diagrams (Sugiyono. 2016:207). Inferential statistics are used to analyze the sample data and the results are applied to the population. Before testing, the normality test and linearity test are first carried out.

Normality test is used to determine whether the distribution of each independent variable has a normal distribution or not. The Interval Coefficient of Normality Interpretation Test is carried out using the Shapiro Wilk test, which is as follows:

$$K_D = 1{,}36\ \frac{\sqrt{n1 + n2}}{n1 + n2}$$

KD: Shapiro Wilk Value
n1: Number of samples observed
n2: Expected number of samples

The calculation results are then consulted with $\alpha = 0.05$ in the table. If the calculation results show that the Shapiro Wilk value is equal to or greater than the table price, then the data is normally distributed (Sugiyono, 2013).

The linearity test aims to determine whether the data is linear or not. The linearity level of the data pairs of variables X and Y is approached using the SPSS application.

Hypothesis testing, in this study, has been done using Simple Regression Analysis. Siregar, S. (2017:379) explains that simple linear regression analysis is used to measure the magnitude of the influence or independent variables. Regression analysis used in this study is simple regression analysis because there is only one independent variable (X) studied to predict the value of the dependent variable (Y). The simple linear regression equation is formulated as follows:

$$Y = a + b\,.X$$

Y = dependent variable
X = independent variable
a and b = Constant

3. Result and Discussion

From the results of the analysis that has been done, it can be seen in table 1 that in a sample of 30 students the highest score is 119 and the lowest score is 87, then the mean is 104.86 with a standard deviation of 9.5402.

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Laboratory Facilities	30	87	119	104.86	9.54
Valid N (listwise)	30				

Table 1: Descriptive Analysis Results of CNC Laboratory Facilities

Based on the frequency distribution in table 2, it can be seen that in the range 85-90, there are 3 students, in the range 91-96, there are 4 students, in the range 97-102, there are 5 students, in the range 103-108, there are 6 students, in the range 109-114, there are 6 students, and in the range 115-120 there are 6 students. Based on the data analysis of the trend score of laboratory facilities in table 3, it can be seen that of the 30 samples in the Mechanical Engineering Education Department, the tendency of students in the medium category was 18 students with a percentage of 60%, in the high

category there were 6 students with a percentage of 20% and in the low category there are 6 students with a percentage of 20%. From the table above, it shows that the tendency of the score of CNC laboratory facilities is in the medium category.

Interval	Frequency	Percentage
85 – 90	3	10%
91 – 96	4	13%
97 – 102	5	17%
103 – 108	6	20%
109 – 114	6	20%
115 – 120	6	20%
Sum	30	100%

Table 2: CNC Laboratory Facility Frequency Distribution

No.	Interval	Category	Frequency	Percentage
1	≥115	High	6	20%
2	115 – 95	Medium	18	60%
3	≤95	Low	6	20%
Sum			30	100%

Table 3: Trend Frequency Distribution of CNC Laboratory Facilities

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Student	30	65	100	83.33	9.22
Achievement Valid N	30				
(listwise)					

Table 4: Descriptive Analysis Results of CNC Course Achievement

Interval	Frequency	Percentage
65 – 70	3	10%
71 – 76	3	10%
77 – 82	8	27%
83 – 88	9	30%
89 – 94	2	6%
95 – 100	5	17%
Sum	30	100%

Table 5: CNC Laboratory Facility Frequency Distribution

From the results of the analysis that has been carried out, it can be seen in table 4 that the highest score is 100 and the lowest value is 65, then the mean is 83.33 with a standard deviation of 9.222 and the number of students is 30. From the frequency data and calculations above, a frequency distribution can be made which can be done with the following steps using the Sturges formula.

Based on the frequency distribution table 5, it can be seen that in the range of 65-70, there are 3 students, in the range of 71-76, there are 3 students, in the range of 77-82, there are 8 students, in the range of 83-88, there are 9 students, in the range of 89-94, there are 2 students and in the range of 95-100, there are 5 students. The highest percentage found in the range of 83-88 is 9%.

Based on the results of the analysis above, it can be determined that the categorization of the tendency of students' learning achievement scores in the frequency distribution table of students' learning achievement tendencies is as follows.

No.	Interval	Category	Frequency	Percentage
1	≥95	High	7	23.30%
2	94 – 75	Medium	18	60%
3	≤75	Low	5	16.70%
Sum			30	100%

Table 6: Trend Frequency Distribution of CNC Laboratory Facilities

Based on the data analysis of the trend of learning achievement scores in table 4.8 above, it can be seen, from a sample of 30 students, that the tendency of student achievement scores is in the medium category with a frequency value of 18 and a percentage of 60%.

Normality test is used to determine whether each variable used in the study is normally distributed. The normality test of the data in this study used the SPSS 21.0 program with the Shapiro Wilk analysis technique. That is by comparing the data distribution with the normal distribution. The basis of decision making used is if sig. > 0.05, then the data distribution can be said to be normal. Normality test results can be shown in table 7.

Test of Normality						
	Kolmogorov-Smirnov[a]			Saphiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
CNC Laboratory Facilities	0.106	30	.200*	0.954	30	0.215
Student achievement	0.162	30	.044*	0.94	30	0.092

Table 7: Normality Test Result of Saphiro-Wilk Analysis

The table of normality test results with the help of SPSS 21.0 above shows that the data from the analysis of the normality test of Variable X (laboratory facilities) obtained a significance value of 0.215 and the results of the normality test of variable Y (student learning achievement) obtained the same significance value of 0.092. This shows that the significance value obtained is greater than 0.05; so, each data obtained is normally distributed.

The linearity test aims to determine whether the independent variable and the dependent variable have a linear relationship or not. The test criteria are if the value of sig. is > 0.05, the relationship between the independent variable and the dependent variable is said to be linear. Conversely, if the value of sig. is <0.05, the relationship between the independent variable and the dependent variable is said to be non-linear. The following table shows the results of the linearity test of the data that has been processed using SPSS 21.0.

ANOVA Table							
			Sum of Squares	Df	Mean Square	F	Sig
Student achievement	Between Groups	(Combined)	1308,333	20	65,417	508	.900
		Linearity	521,587	1	521,587	4,057	.075
		Deviation from Linearity	786,746	19	41,408	.322	.982
CNC Laboratory Facilities	Within Groups		1158,333	9	128,704		
	Total		2466,667	29			

Table 8: Results of Data Linearity Test Analysis

Based on the results of the linearity test analysis in table 8, it can be seen that the data obtained a significance value of 0.982 > 0.05, which means the research data is linear.

Sugiyono (2018: 62-70) suggests that to carry out the regression significance test, what is needed is the T test or commonly referred to as the Analysis of Variance (ANOVA). The T test is the initial stage in identifying the regression model which is estimated to be meaningful or not. The following table shows the results of the T test analysis, that has been analyzed, using SPSS 21.0 and is displayed in the form of an ANOVA in table 9.

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig
		B	Std. Error	Beta		
1	(Constant)	36.717	17.080		2.150	.040
	X Variable	.445	.162	.460	2.740	.011

Table 9: Simple Linear Regression Analysis Results

Based on the data presented in table 9, it is obtained that the significance value is 0.011 (p < 0.05) and the t-test value is 2.740> and t-table is 2.048. Thus, CNC laboratory facilities have a positive effect on student achievement in the NC/CNC machine practice course, Department of Mechanical Engineering Education, Makassar State University.

Based on the analysis of 30 samples of Mechanical Engineering Education, students from the facility score trend data are in the medium category with a class interval value of 115-95 as many as 18 students. As for the questionnaire grid, it is divided into 5 major groups; from the large group several sub-indicators appear and the one that gets the highest points is the work area indicator; the sub-indicator of the CNC machine work area of 101 points is seen when observations in the work area are very adequate, as well as from other equipment indicators, the K3 tool sub-indicator is 100, where K3 has a large share during the practicum. The lowest points were found in the furniture indicator at 54 and other equipment at 49 points because in the laboratory room there was no fire extinguisher. Meanwhile, the trend data for student achievement scores was in the medium category with a score of 94-76 obtained by 18 students. Judging from these indicators, the most influencing indicator is the facility indicator in the CNC machine work area because this indicator has the highest value from other indicators, so that the CNC laboratory facility variable has an influence on students' learning achievement of 21.1%. Based on the results of this study, it can be explained that the more complete or adequate laboratory facilities, the higher students' learning achievement in NC/CNC machine work practices.

CNC laboratory facilities are tools and equipment as well as support to facilitate the learning process of CNC machining practices on an ongoing basis. The feasibility of CNC laboratory facilities is one of the most influential factors in improving student learning achievement. On the other hand, if the CNC laboratory facilities are not feasible, it will hinder students from doing practical assignments given by the lecturers in the laboratory, so that their practice results will also decrease as well as their learning achievement.

Based on the results of the research above, it can be concluded that there is a positive influence on CNC laboratory facilities on students' achievement in the NC/CNC machining practice course, Makassar State University, Mechanical Engineering Education. NC/CNC is affected by laboratory facilities where the results of the analysis show the coefficient of determination is 0.211 or 21.1%.

This means that there is a large 21.1% contribution of the influence of laboratory facilities to the practice of NC/CNC machines, while the remaining 78.9% is influenced by other variables such as: Physiological conditions, interest in learning, level of intelligence or intelligence, motivation, talent, lecturers and learning arrangements on campus.

4. Conclusion

Based on research that has been conducted on the effect of CNC laboratory facilities on student achievement in NC/CNC machining practice courses, Mechanical Engineering Education, Makassar State University, it can be concluded that laboratory facilities have a positive effect on students' achievement in NC/CNC machining practice courses in the Department of Engineering Education, Makassar State University, with an influence of 21.1%, while the remaining 78.9% is influenced by other variables such as: Physiological conditions, interest in learning, talent, intelligence or intelligence, lecturers and learning systems on campus.

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ISSN 2321 – 919X

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The International Journal of Science & Technoledge

Is hereby awarding this certificate to

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In recognition of the publication of the paper entitled

The Influence of CNC Laboratory Facilities on Students' Learning Achievement in NC/CNC Machinery Practical Courses of Mechanical Engineering Education, Universitas Negeri Makassar

Published in 'The IJST' Journal Volume X, Issue 6, June, 2022

DOI No.: 10.24940/theijst/2022/v10/i6/ST2206-003

R. K. Swarnakar

Editor in Chief